(12) UK Patent Application (19) GB (11) 2 184 811 (13) A

(43) Application published 1 Jul 1987

(21) Application No 8630090

(22) Date of filing 17 Dec 1986

(30) Priority data
(31) 814920 (32) 30 Dec 1985 (33) US

(51) INT CL⁴
F16D 3/84 F16J 15/52

(52) Domestic classification (Edition I):
F2U 503 531 534 541 572
F2B 13C3
U1S 1820 2021 F2B F2U

(56) Documents cited
None

(58) Field of search
F2U
F2B
Selected US specifications from IPC sub-classes F16D
F16J

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(54) Sealing universal joints

(57) A boot restraint member (38) for a rotatable torque transmitting mechanical joint of the plunging type, is of plastics material and comprises a portion (39) of generally cylindrical annular form arranged to fit on an end portion (29) of the boot on the outer joint member, and has a radially inwardly extending rib (42) which has an internal diameter normally less than an external diameter of the end portion of the boot, the boot restraint member being elastically deformable to be fitted over the end portion of the boot and to be retained thereon by interference between the internal diameter of the rib and the external diameter of the boot.

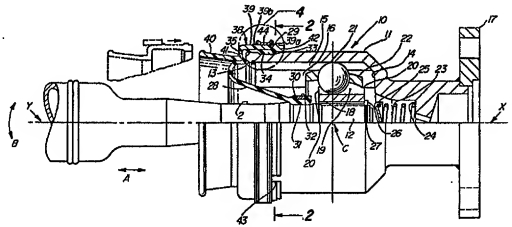

Fig-1

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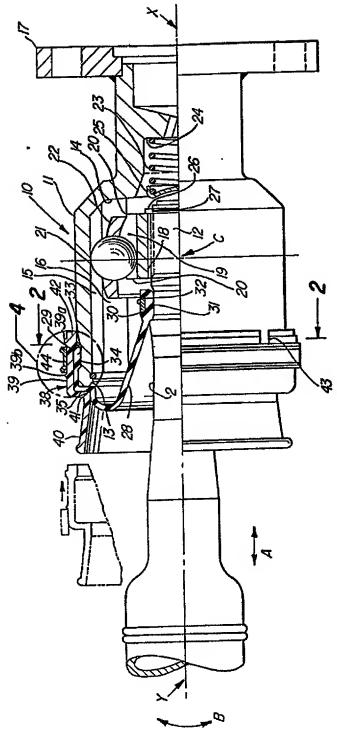

Fig-1

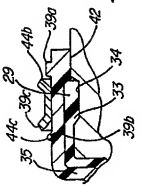

Fig-4

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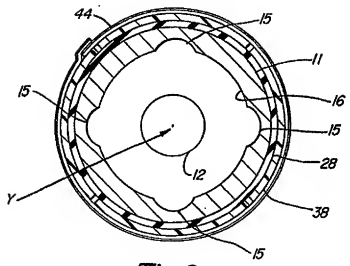

Fig-2

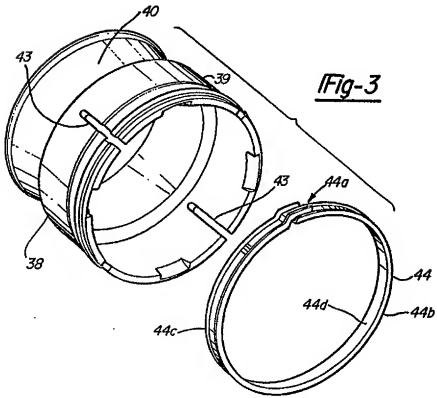

Fig-3

SPECIFICATION

Boot restraint for plunging universal joint

This invention relates to a member for restraining movement of a flexible annular sealing member, usually and hereinafter termed a boot, of a plunging type of universal joint.

Plunging types of constant velocity ratio universal joints are widely used in automotive drive lines. A typical joint comprises an outer joint member that is open at one end and has grooves extending into its interior from such open end, and an inner joint member that is disposed at least partly within the outer joint member and has grooves which face the grooves in the outer joint member. Balls are disposed one in each facing pair of grooves in the joint members for torque transmission therebetween, while permitting both angular movement (articulation) and axial (plunging) movement between the joint members. A flexible annular boot has one end sealingly connected to the outer joint member and its other end sealingly connected to the inner joint member, to retain lubricant such as grease in the joint and to prevent contamination by ingress of water or dirt in use.

An automotive constant velocity universal joint may be subject to operation at relatively high rotational speeds, particularly if it is in a vehicle's propeller shaft connecting to a differential unit. At such high rotational speeds, centrifugal force can cause the flexible boot to become distorted and balloon out in service, partly due to the mass of the boot itself and partly due to the mass of the grease contained therein. Such distortion of the boot can lead to failure of the boot itself or of the seal between the boot and the outer joint member, which inherently is at a large diameter compared with the inner joint member. Further, the grease is thrown away from the region of the relatively moving parts of the universal joint, posing the danger of inadequate lubrication thereof during a prolonged period of high speed operation.

Hitherto this problem has been solved by the use of a spun metal boot restraint that surrounds the portion of the boot that is connected to the outer joint member to maintain the seal and to restrain outward movement of the adjacent portion of the boot. An example of such a spun metal boot restraint is disclosed in US Patent 3,822,570. Such a spun metal boot restraint, however, has a disadvantage in that it is partially roll-formed in place on the outer joint member, and the rolling action tends to cause twisting of the boot which can lead to premature boot failure. Also, once the spun metal boot restraint is in place, it cannot be removed without destruction thereof, and usually, in addition, without destruction of the boot itself. Therefore, servicing of a joint fitted with such a spun metal boot restraint is difficult and expensive.

It is the object of the present invention to provide a boot restraint in which the above mentioned disadvantages are overcome or reduced. Thus, the boot restraint should be capable of being assembled to a joint without a rolling operation, and desirably is capable of being removed from the joint without destruction or damage to the boot restraint or the boot itself, enabling re-use of the boot restraint and boot.

According to the present invention, we provide a boot restraint member for a rotatable torque transmitting mechanical joint of the plunging type, the joint comprising an outer joint member, an inner joint member and a flexible annular boot having a first end sealingly connected to said outer joint member on an external circumferential surface thereof, and a second end sealingly connected (directly or indirectly) to said inner joint member; said boot restraint member comprising a portion of generally cylindrical annular form arranged to fit on said first end portion of the boot and having a radially inwardly extending rib means which has an internal diameter normally less than an external diameter of said first end portion of the boot, and said boot restraint member being elastically deformable to be fitted over said first end portion of the boot and to be retained thereon by interference between said internal diameter of the rib means of the boot restraint member and said external diameter of said first end portion of the boot.

A boot restraint member according to the invention can be preformed from a semi-rigid plastics material, and readily applied to the universal joint without the need for spinning or rolling operations. Twisting of the boot during assembly of the boot restraint member is thus avoided. Further, the boot restraint member may readily be removed without destruction, to permit re-use of the boot restraint member and boot if they are otherwise fit for re-use. The boot restraint member is preferably integrally formed from a thermo-plastics material, e.g. a polyamide (nylon) or other semi-rigid puncture resistant polymeric material. It may be made by injection moulding and will have sufficient resiliency to be capable of assembly on the joint member by elastic deformation of the boot restraint member.

The invention also provides a universal joint having a boot restraint member according to the invention as above set forth.

The invention will now be described by way of example with reference to the accompanying drawings, of which:

Figure 1 is an elevation; partly in section, of a universal joint assembly including a boot restraint member according to the present invention;

Figure 2 is a cross-section on the line 2-2 of Figure 1; and

Figure 3 is an exploded perspective view

showing the boot restraint member;

Figure 4 is an enlargement of part of Figure 1.

Referring firstly to Figure 1 of the drawings, there is shown a plunging type of constant velocity ratio universal joint. The type of joint is generally known and accordingly will not be described in great detail herein. However, the joint 10 comprises an outer member 11 which is generally in the form of a hollow cylinder open at one end, within which is disposed an inner joint member 20. The outer joint member 11 has a longitudinal central rotary axis X, and the inner joint member 20 a longitudinal central rotary axis Y, and in Figure 1 these axes are in alignment with one another.

The outer joint member has an open end 13 and a closed end 14, the latter extending to be connected by welding to a flange 17 for torque transmission to or from the outer joint member. The inner joint member comprises an annular member 20 received on an end portion 12 of a shaft 2 which may be a vehicle propeller shaft, the member 20 being rotationally fast on the end portion 12 of shaft 2 by inter-engaging splines or a drive key arrangement 18, and is held thereon by a circlip or spring ring 26 engaging a groove 27 at the end of the shaft portion 12.

The outer joint member 11 is provided in its interior with a plurality of circumferentially spaced axially extending rectilinear grooves 15, extending into the outer joint member from the open end 13 thereof. The inner joint member 20 is provided with circumferentially spaced rectilinear axial grooves 19 each of which faces one of the grooves 15 in the outer joint member. A plurality of balls 21 are disposed one in each facing pair of grooves in the inner and outer joint members, for torque transmission between the joint members. The balls occupy apertures in an annular ball cage 22 which constrains them so that their centres lie in a common plane, whilst they are permitted to move axially along the grooves 15, 19. In known manner, the inner joint member is free to move axially within the outer joint member along the central axis X thereof as indicated by arrows A in Figure 1, and to articulate relative to the outer joint member about a point C where the plane containing the centres of the balls 21 intersects the axis X, this articulation being indicated by arrows B in Figure 1. Typically the permissible angular movement (articulation) of the inner joint member relative to the outer joint member is of the order of 20 degrees from the aligned condition illustrated.

A spring 23, abutting a surface 24 at the closed end 14 of the outer joint member and acting on a shaped plate 25 which bears against the end of shaft portion 12, is provided to bias the inner joint member towards the open end of the outer joint member. Not all plunging constant velocity universal joints incorporate such springs, and the present invention is equally applicable to such joints. Further, the invention is applicable to joints in which torque is transmitted by means other than balls, e.g. a tripode type of joint.

To lubricate the working parts of the universal joint, namely the balls 21 and the grooves they engage in the joint members, and the cage 22, a quantity of lubricant, normally grease, is contained in the joint. The lubricant is contained in the joint by a flexible annular sealing boot 28 which has a first end 29 sealingly connected to the outer joint member, and a second end 30 sealingly connected to the inner joint member, actually to a part of the shaft end portion 12. To be able to accommodate axial and angular displacement of the inner joint member relative to the outer joint member, the boot 28 is formed of a flexible material, usually an elastomeric material.

The second end 30 of the boot 28 is held in position within a groove 31 in the shaft portion 12 by a removable retaining ring 32. The first end 29 of the boot 28 is retained on the external circumferential surface of the outer joint member 11 by providing the end 29 of the boot with a radially inwardly projecting rib 33 which is received in a radially inwardly extending recess 34 in the form of an annular groove on the outer joint member. The boot 28 further has a radially inwardly extending annular portion 35 which lies in face-to-face contact with an end surface at the open end of the outer joint member, thereby to form a seal with the outer joint member both at the external circumferential surface thereof and at the radially extending annular end surface thereof.

The first end 29 of the boot 28 is retained in its desired position on the outer joint member 11 by a shaped boot restraint member 38 that also partially shrouds the boot to help protect it from damage, i.e. inadvertent rupture or puncture, and to help prevent the boot from ballooning out when the universal joint rotates at high speed. It will be appreciated that the mass of lubricant grease contained within the universal joint and boot makes the boot vulnerable to such deformation at high rotational speed. The boot restraint member 38 is less flexible than the material of the boot, and is formed in a single piece from a suitable semi-rigid, puncture resistant organic material such as a polyamide material, e.g. by injection moulding. A material known as Dupont "Super Tough Nylon ST801" has been found to be suitable for manufacture of a boot restraint member by injection moulding.

The boot restraint member 38 has a portion 39 which is of annular generally cylindrical form, a portion 40 which is generally of frusto-conical shape, and a radially extending connecting portion 41 between the portions 39, 40. Portion 39 of the boot restraint mem-

ber 38 terminates in a radially inwardly extending rib 42 which, when installed, projects beyond the end 29 of the boot 28 and has a normal inside diameter less than the outside diameter of the end 29 of the boot. Portion 39 of the boot restraint member has a plurality of circumferentially spaced axially extending slots 43 therein (best seen in Figure 3), to permit the portion 39 as a whole to expand radially to permit it to be snap fitted axially over the end 29 of the boot.

When thus fitted, the boot restraint member is retained by the interference between rib 42 and the end portion 29 of the boot 28. Positively to secure the boot restraint member, a removable clamp 44 is fitted on the exterior of the cylindrical portion 39 of the boot restraint member. For servicing purposes, clamp 44 can be removed whereafter the boot restraint member can be removed axially by deformation (radial expansion) of portion 39.

The removable clamp 44 comprises a double ended band of metal, e.g. steel, of which the ends overlap as shown at 44a in Figure 3. The overlapping ends are spot welded to one another. Clamp 44 has edges 44b, 44c, joined by a cylindrical connecting portion 44d, and when assembled on the boot restraint member lies between outwardly projecting ribs 39a, 39b of the cylindrical portion 39 of the boot restraint member. The rearmost, 39b, of the ribs 39a and 39b has an outer surface, 39c, which tapers so that the clamp 44 can be moved into position between the outwardly projecting ribs 39a and 39b by sliding it inwardly and upwardly over the outer surface 39c of rib 39b. This is possibly because of the deformability inherent in the boot 28 and the boot restraint member 38, by virtue of the materials from which they are formed.

The radially extending connecting portion 41 of the boot restraint member 38 is so positioned with respect to the rib 42 that it will compress the radially extending portion 35 of the boot 28 against the end surface of the outer joint member 11. A double seal, at such radial surface as well as the circumferential surface, is thus provided between the boot and the outer joint member. The small diameter end of the frusto-conical portion 40 of the boot restraint member is so positioned as to contact an outer portion of the boot 28 to prevent the latter from being displaced outwardly during rotation of the universal joint, so that the lubricant contained within the universal joint will stay in contact with the balls and other working parts therein. The frusto-conical configuration of portion 40 of the boot restraint member ensures that such protection is provided at all relative axial positions of the inner and outer joint members encountered in normal use. Further, frustoconical portion 40 of the boot restraint member also serves to shroud the boot to protect it from damage due to contact with rocks or other road hazards likely to be encountered in use.

CLAIMS

1. A boot restraint member for a rotatable torque transmitting mechanical joint of the plunging type, the joint comprising an outer joint member, an inner joint member and a flexible annular boot having a first end sealingly connected to said outer joint member on an external circumferential surface thereof, and a second end sealingly connected to said inner joint member; said boot restraint member comprising a portion of generally cylindrical annular form arranged to fit on said first end portion of the boot and having a radially inwardly extending rib means which has an internal diameter normally less than an external diameter of said first end portion of the boot, said boot restraint member being elastically deformable to be fitted over said first end portion of the boot and to be retained thereon by interference between said internal diameter of the rib means of the boot restraint member and said external diameter of said first end portion of the boot.

2. A boot restraint member according to Claim 1, further comprising an annular portion extending radially inwardly from said cylindrical portion thereof, and arranged to hold a part of said flexible boot adjacent said first end thereof in sealing engagement with a radially extending annular end surface of said outer joint member.

3. A boot restraint member according to Claim 2 further comprising a generally frusto-conical portion having a small end and a large end, the small end being connected to said radially extending annular portion of the boot restraint member, the frusto-conical portion being arranged to restrain outward movement of at least part of the flexible annular boot.

4. A boot restraint member according to any one of the preceding claims wherein said generally cylindrical portion thereof has slots extending therein to from the free end thereof.

5. A boot restraint member according to Claim 4 wherein said slots end before reaching said radial annular portion.

6. A boot restraint member according to any one of the preceding claims wherein it is integrally formed from a thermoplastics material.

7. A boot restraint member according to Claim 6 wherein said material is a polyamide material.

8. A boot restraint member according to Claim 6 or Claim 7, made by injection moulding.

9. A rotatable torque transmitting mechanical joint of the plunging type, the joint comprising an outer joint member of generally hollow cylindrical form, open at one end and having an external circumferential surface; an inner joint member disposed at least partly within said outer joint member; torque

transmitting means connecting said outer and inner joint members for relative articulation and movement along a rotary axis of the outer joint member; a flexible annular boot having a first end sealingly connected to said outer joint member on said external circumferential surface thereof, and a second end sealingly connected to said inner joint member; and a boot restraint member of an organic material less flexible than the boot material and comprising a portion of generally cylindrical annular form fitted on said first end of the boot and having a radially inwardly extending rib means which has an internal diameter normally less than an external diameter of said first end portion of the boot, to retain said boot restraint member by interference between said internal diameter of the rib means of the boot restraint member and said external diameter of said first end of the boot, said generally cylindrical portion of the boot restraint member being elastically distortable such that said inwardly extending rib means thereof can be radially expanded to an internal diameter greater than said boot external diameter, to permit said portion of the boot restraint member to be fitted axially over said first end of the boot.

10. A joint according to Claim 9 wherein the outer joint member has a radially inwardly extending circumferential groove in said external circumferential surface thereof, and said first end of the boot has a radially inwardly projecting rib engaging in said groove.

11. A joint according to Claim 9 or Claim 10 further comprising removable retaining means surrounding said generally cylindrical portion of the boot restraint member, to maintain said interference.

12. A joint according to Claim 11 wherein said boot restraint member has a radially outwardly facing groove means wherein said retaining means is received.

13. A joint according to Claim 10, wherein said outer joint member has a planar annular end surface, said boot has an annular radially extending portion sealingly engaging said end surface, and said boot restraint member has an annular portion extending radially inwardly from said generally cylindrical portion thereof, engaging said annular radially extending portion of the boot to hold it in said sealing engagement.

14. A joint according to Claim 13 wherein said boot restraint member further comprises a generally frusto-conical portion having a small end and a large end, the small end being connected to said radially extending annular portion of the boot restraint member and the frusto-conical portion being arranged to restrain outward movement of part of the boot.

15. A joint according to any one of Claims 9 to 14 wherein said generally cylindrical portion of the boot restraint member has slots [illegible] therein to from the free end thereof.

16. A joint according to Claim 15 wherein said slots end before reaching said radial annular portion.

17. A joint according to any one of Claims 9 to 16 wherein the boot restraint member is integrally formed from a thermoplastics material.

18. A joint according to Claim 17 wherein said material is a polyamide material.

19. A joint according to Claim 17 or Claim 18, wherein the boot restraint member is made by injection moulding.

20. A boot restraint member, or a universal joint having a boot restraint member, substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987. Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.